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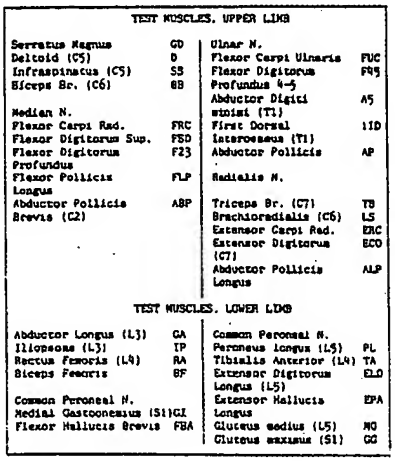

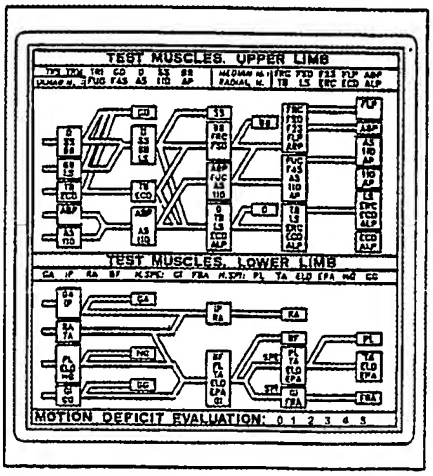

(57) Abstract

An electronic apparatus is described hereafter which, in function of motion deficits ascertained in test muscles permits to localize the site of lesions of the peripheral nervous system brachial plexus and the lumbosacral plexus. The electronic apparatus is suitable for displaying at least two anatomic diagrams (4, 6) representing the two plexuses: at each branching point of said diagrams and in correspondence of the relevant twigs, a case is located containing test muscles (of the upper and the lower limb respectively) innervated by the corresponding portion of the nervous system. Function keys (8) permit the operator to select and mark test muscles showing a motion deficit; the case containing all test muscles whose motion deficit is considered as significant for a specific lesion is identified as the site of the lesion. In a particular embodiment, the apparatus allows to localize the probable site of possible nervous lesions also through the analysis of the patient's sensorial complaints.

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ELECTRONIC APPARATUS FOR LOCALIZING LESIONS OF PERIPHERAL NERVOUS SYSTEM

TECHNICAL FIELD

The object of this invention is an electronic apparatus which, in function of motion deficits ascertained by a physician (or anyway by a qualified operator) in suitably chosen muscles (in the following referred to as "test muscles"), permits to make rapidly a first diagnosis, localizing with good success chances the probable sites of lesions of the peripheral nervous system which constitutes the brachial plexus or the lumbosacral plexus respectively.

By "test muscles" one means therefore muscles of the upper or lower limb respectively, whose efficiency can be considered as an indication of the functionality of the nervous branch (of the peripheral nervous system which constitutes the brachial plexus and the lumbosacral plexus respectively), by which they are innervated.

The physician shall evaluate each time the opportunity of confirming by means of more accurate electromyografical examinations the first diagnosis made by means of the apparatus object of this invention.

The electronic apparatus object of this invention is suitable for displaying at least two anatomic diagrams which show (in the various steps starting from the motor roots up to the twigs) the peripheral nervous system which constitutes the brachial plexus and the lumbosacral plexus respectively: for each step (corresponding to a branching point of the relevant diagram), the anatomic diagram

comprises a case containing the initials that identify the test muscles (of the upper limb and the lower limb respectively), innervated by the corresponding portion of the peripheral nervous system.

Further cases, located at the end of the twigs of the peripheral nervous system, contain the initials of the test muscles whose motion deficit suggests a lesion of the corresponding twig.

A number of keys permits to select and mark test muscles that show a motion deficit; the site of the lesion is localized in the case where all test muscles are marked whose motion deficit is considered as significant because of the particular lesion level.

The electronic apparatus will be described in detail with reference to an embodiment consisting of an electronic ruler equipped with a commercial-type display without graphic capabilities: anyway, without overstepping the field of this invention, a second embodiment of said apparatus is possible, said second embodiment consisting of an electronic ruler equipped with a display (for instance a liquid crystal colour display) having graphic capabilities, such as to permit to display, among other things, pictures utilized for the so-called "sensorial analysis".

BACKGROUND ART

Any physician, general practitioner or specialist (neurologist, neurosurgeon, physiatrist, orthopedist, etc.) as he may be, has often to examine patients showing motion deficits of muscles or

muscle bundles which are most probably due or anyhow associated to lesions of the peripheral nervous system.

Many diagnostic techniques (based on the clinical examination of the patient and/or the results of even very complex electromyographical examinations) are known and widely used in medicine, which allow to evaluate the functionality of the peripheral nervous system which constitutes the brachial plexus and the lumbosacral plexus respectively: such diagnostic techniques can be utilized to localize the site of a possible nervous lesion causing the motion deficit ascertained in the patient's muscles.

The peripheral nervous system has a very complex structure, branched and intricate (suffices to consider as a mere example the fact that muscles of a same body region may be innervated by fibres coming from several nervous roots): in fact, to reach the muscles of the limbs, the axons follow a path which is not only long but also complicated by their redistribution in the plexus mingling, especially that of the brachial plexus.

Coming from the various spinal nervous roots, they divide first, to then group again in the primary and secundary nervous trunks and in the individual nervous trunks, mingling with one another in different ways.

As a consequence, a muscle motion deficit may be due to a lesion localized in very different sites of the peripheral nervous system, and a lesion may cause motion deficits of different muscles,

depending on the nervous trunk involved.

Knowing the level and the exact localization of a lesion is therefore essential for an accurate diagnosis, an adequate therapy and a realistic prognosis.

A possible approach to the problem could be to identify the deficient muscles and the normal ones, and starting from this combination try to localize the site of the lesion, remembering the path and the minglings of the axons that innervate the alterated muscles: such an approach requires to be familiar with such pathology and a certain mnemonic effort, unless one can resort to diagrams representing the peripheral nervous system; referring to such diagrams - if they are complete - is generally a complex and difficult operation.

Because of the above mentioned reasons, localizing the site of a possible lesion is a long and hard operation, as it involves the necessity of comparing and integrating the anatomico-functional information inferred from the examination of the diagrams and from more or less exhaustive texts with the information inferred from the patient's clinico-electromyographical examinations.

The electronic apparatus objet of this invention allows to obviate such drawbacks and to make in a simple and rapid way a first diagnosis (having good chances of being correct) based on the motion deficits ascertained on the patient's muscles, sparing the physician the hard and boring comparison, integration and synthesis work as

described above: in a particular embodiment, the apparatus according to this invention allows to localize the probable site of possible nervous lesions also through the analysis of the sensorial disturbances complained by the patient.

DISCLOSURE OF THE INVENTION

The invention consists in an electronic apparatus for localizing, at least in function of motion deficits ascertained in test muscles of the upper limb and the lower limb respectively, the site of lesions of the peripheral nervous system which constitutes the brachial plexus and the lumbosacral plexus respectively.

Such electronic apparatus comprises means suitable for displaying at least:

- two anatomic diagrams representing the peripheral nervous system which constitutes the brachial plexus and the lumbosacral plexus respectively;
- a set of cases located at the branching points and in correspondence with the twigs of the two anatomic diagrams: each case contains the initials of the test muscles that are innervated by a portion of the peripheral nervous system, whose motion deficit is (or may be) associated to a lesion of said portion of the peripheral nervous system;
- means suitable to indicate as the site of the lesion the case containing the initials of all test muscles whose motion deficit is considered significant for the particular lesion level, said

deficient test muscles being marked by mean of function keys;

and further provides for the presence of a set of said function keys which allow at least to scan said test muscles and to mark those that show a motion deficit.

BRIEF DESCRIPTION OF DRAWINGS

The electronic apparatus according to this invention will be now described with the help of an embodiment - not to be considered as a limitation - consisting of an electronic ruler, illustrated in the drawings attached herewith, wherein:

- Fig. 1 is a diagram of the ruler according to this invention;
- Fig. 2 is a perspective view of the ruler of Fig. 1, showing its book-like shape;
- Fig. 3 is a logic diagram, suitable to better illustrate the working of the ruler according to this invention;
- Fig. 4 and 5 are examples of some of the explanatory pictures included in the instruction handbook supplied with the ruler;
- Fig. 6 and 7 are examples of some of pictures utilized for the so-called "sensitive analysis".

MODES FOR CARRYING OUT THE INVENTION

Fig. 1 is the diagram of an electronic ruler realized according to this invention and constituted by two valves folding like a book, as illustrated more clearly on Fig. 2.

To explain in a still clearer way the working of the ruler object of this invention, on Fig. 1, on the internal surface of the first

valve 1, which constitutes the ruler's lid, a list (extrapolated from an instruction handbook not illustrated in the pictures for simplicity) of the test muscles that innervate the upper limb and the lower limb respectively is given; near each test muscle the initial is specified which identifies said test muscle in the two anatomic diagrams of the second valve 2 which comprises, in order,

- a first area 3 comprising the initials of the upper limb test muscles; some of said initials have been grouped, especially for mnemonic convenience, according to the three main nervous trunks (median, ulnar and radial nerve) by which said test muscles are innervated;
- a first anatomic diagram 4, representing the peripheral nervous system which constitutes the brachial plexus, with the indication of the motor roots and of the various nervous trunks formed in succession up to the twigs: at each branching point and in correspondence of each twig, the first anatomic diagram 4 shows a case containing the initials of the test muscles of the upper limb whose motion deficits evidence the existence of a lesion localized in the branching point or in the twig respectively;
- a second area 5 containing the initials of the lower limb test muscles: some of said initials have been grouped, especially for mnemonic convenience, according to the two main nervous trunks (internal and external popliteal hischiatic nerve) by which said test muscles are innnervated;

- a second anatomic diagram 6, representing the peripheral nervous system which constitutes the lumbosacral plexus, with the indication of the motor roots and of the various nervous trunks formed in succession up to the twigs: at each branching point and in correspondence of each twig, the second anatomic diagram shows a case containing the initials of the test muscles of the lower limb whose motion deficits evidence the existence of a localized lesion in the branching point or in the twig respectively;

- a third area 7 comprising, in coded form, the evaluation of the possible motion deficit of a test muscle; conventionally, a perfectly working test muscle has an evaluation = 5, while a totally deficient test muscle has an evaluation = 0;

- a set of function keys 8 which permit to select test muscles, to mark those that show motion deficits, to associate to the marked test muscles the evaluation of the corresponding motion deficit and to display the lesion site.

Must be noted that the same test muscle often appears in two or more cases, as its motion deficit may be due to lesions localized in different points of the peripheral nervous system.

In the ruler described herein, the first, second and third areas (3, 5 and 7) and the first and second anatomic diagrams (4, 6) are shown by means of a display 9 (or any other equivalent display means) which can be found on the market and has no graphic capabilities; according to an embodiment that will be described later on, the

ruler is equipped with a display provided with advanced graphic capabilities, and the physician can recall on the display of the ruler one of the anatomic diagrams (4, 6), either individually or together with the relevant lists of test muscles (3, 5); the evaluation of the possible motion deficit of each test muscle can be displayed on the display either by a panel analogous to the third ruler area (7) or by means of the colour of the muscle initial in all the cases of the anatomic diagram in which such muscle shows up.

According to a possible embodiment of this invention, the lesion site is displayed by permanently switching on the case in which all and only the test muscles are marked whose motion deficit is considered to be significant for the particular lesion type; according to another possible embodiment of this invention, the highlighted case comprises, besides all the marked test muscles, also other (unmarked) test muscles whose possible motion deficit may not be significant for the particular lesion type.

We refer in particular to some types of multiple lesions, well known to the specialist, in which the condition (normal or alterated) of some muscles is not particularly relevant at a given level (for instance at the root), while becomes very relevant at a different level of the nervous system.

The following tables (concerning the upper and the lower limb respectively) are an example of combinations of normal (unmarked)

muscles, alterated ("A"-marked) muscles, and indifferent ("X"-marked) muscles, which are relevant for the various sites of possible lesions; in both tables, the initials of test muscles are indicated on the abscissa axis, and the corresponding motor roots and/or nervous trunks are indicated on the ordinate axis.

TABLE I

	C 5	C 6	C 7	C 8	T 1	C 5 - C 6	C 5 - C 6 - C 7	TORACICUS LONGUS	SUPERIOR TRUNCK	INFERIOR TRUNCK	SUPERIOR TRUNCK + MEDIUS TRANCK	MEDIUS TRUNCK + MUSCULO CUTANEOUS N.	LATERAL CORD	MEDIUS CORD	POSTERIOR CORD	POSTERIOR CORD + MUSCULO CUTANEOUS N.	SUPRA SCAPULAR N.	MUSCULO CUTANEOUS N.	MEDIAN N.	ULNAR N.	AXILLARY N.	RADIAL N.	ANTERIOR INTEROSSEUS N.	CARPAL TUNNEL N.	GUJON N.	DEEP BRANCH N.	SPIRAL GROOVE N.	POSTERIOR INTEROSSEUS N.
GD						A	A	A																				
D	A					A	A		A		A				A	A						A						
SS	A					A	A		A		A						A											
BB	X	A				A	A		A		A	A	A			A		A										
FRC							X				X		A							A								
FSD							X				X		A							A								
FL3													X							A				A				
FLP				X						X			X	X						A				A				
ABP				A						A			X	A						A					A			
FUC					X					X				A							X							
FP45					X					X				X							A							
A5					A					A				A							A				A			
1ID					A					A				A							A				A	A		
AP										X				X							A				A	A		
TB			A				A				A	A			A	A							A					
LS		A				A	A		A		A				A	A							A				A	
ERC			X				X				X	X			X	X							A				A	
ECD			A				A				A	A			A	A							A				A	A
ALP				A						A					A	A							A				A	A

A = ALTERED

X = INDIFFERENT

TABLE II

	L 3	L 4	L 5	S 1	OBTURATOR	SUPERIOR GLUTEUS	INFERIOR GLUTEUS	FEMORAL N.	SCIATIC N.	INGUINAL N.	PERONEAL N.	TIBIALIS N.	TASSAL TUNNEL	SUPERFICIAL BRANCH	DEEP BRANCH	L5 - S1
GA	A				A											
IP	A							A								
RA	X	A						A		A						
BF			X	X					A							X
GI				A					X			A				A
FBA				X					X			A	A			X
PL			A						A		A			A		A
TA		A	X						A		A				A	X
ELD			A						A		A				A	A
FPA			X						A		A				A	X
MG			A			A										A
GG				A			A									A

Fig. 2 is a perspective view showing the book-like structure of a ruler realized according to this invention.

Fig. 2 shows the two valves 1, 2 connected to one another, the function keys 8 and the display 9, while the instruction handbook (containing, among other things, the list of test muscles and the relevant initials shown on Fig. 1, and a set of pictures, such as the ones shown as examples on Fig. 4 and 5, which indicate how the physician should examine the individual test muscles to make a correct evaluation of the possible motion deficit) placed inside the first valve 1, and the diagrams (first area 3, first anatomic diagram 4, second area 5, second anatomic diagram 6 and third area 7), realized on display 9, have been omitted for simplicity of the graphic representation.

The working of an electronic ruler realized according to this invention will be now described with reference to a non-limitative embodiment.

On switching on, the anatomic diagram to be utilized is chosen and the initial of the first test muscle is highlighted (for instance, GD muscle for the upper limb; the three heads of the trapezius muscle, TRS, TRM and TRT have not ben indicated explicitly, as they do not make part of the anatomic diagram of the brachial plexus) in the corresponding case of the test muscles (first area 3 or second area 5). At the same time, in the chosen anatomic diagram the initial of the selected test muscle flashes in all the cases in

which it is contained, pointing out therefore its path: if the test muscle is normal, the relevant initial switches off when one goes on to the next (or the preceding) test muscle by means of the special key > (or <).

If, on the contrary, the test muscle examined is deficient, by means of key L and, afterward, of key < (or >), one sets the evaluation of the motion deficit (from 4 = mild deficit to 0 = total deficit), indicated by the flashing of the corresponding number in the third area 7 "MOTOR DEFICIT EVALUATION"), and confirms it by means of key ENT; the initials of deficient test muscles remain highlighted in all the cases in which they are contained: in this way one can localize, also during the examination of the following test muscles, all the deficient muscles in the various cases which contain them.

At the end of the examination (or in any moment whatever during the same), by means of key D the function "EVALUATION OF THE LESION LEVEL" is activated; when for a given level (radicular, primary or secundary trunk, main nerves, twigs), there exists a case that contains all and only alterated test muscles, the corresponding nervous trunk which may be the probable site of the lesion is highlighted by a flashing.

In the evaluation one can take into account all of the muscle deficit levels, from 4 to 0: by pushing the key D only test muscles remain highlighted whose deficit is not lower than the preset level and the probable site of the lesion is localized, if possible, only

on the basis of these muscles; pushing the key > one goes back to less severe deficit levels. A new pushing of key of D permits to resume the muscle examination. As pointed out before, the ruler object of this invention takes into account, in its analysis, some special conditions. In fact, on the one hand some test muscles (BB, ABP, RA and TA) are comprised in two different cases for the same radicular level, while on the other hand, if a complex lesion occurs, the contemporaneous involvement of all the test muscles of several cases (for instance C5-C6-C7 and TPS and TPM) may occur; the normal/alterated condition of the GD test muscle causes one to decide for either of the level. Must be noted that the normal/alterated evaluation of a test muscle and the severity of the observed motion deficits can be modified at any moment, as the system stores the evaluation of each individual test muscle, and therefore any error can be always corrected. Besides, it is possible to recall the evaluation of the motion deficits of the various test muscles by highlighting only those having a deficit exceeding a preset value: such information is (or may be) important for possible subsequent controls.

The ruler switches off automatically, after a preset time from the last key pushing, holding the data previously set: therefore, by switching on the ruler, one can resume the examination procedure from where it had been interrupted.

The logic diagram of Fig. 3 is a "translation" in a graphic form of

the ruler working according to the above described invention.

When the ruler is switched on (key ON, step 1), the last anatomic diagram used (concerning either the upper limb or the lower limb) is displayed again (step 2, US), as it appeared at the moment it had been switched off (we remind that on switching off the ruler, all the data previously set are stored): this allows the physician to resume the examination procedure (step 10, CM) from where it had been interrupted (for any reason whatever).

By pushing a function key (for instance key ON; step 3, TP), the physician starts up a new examination procedure, initializing the ruler (step 4, INIT), i.e. resetting the storage and the logic circuit which scans muscles cyclically and setting the evaluation of the motion deficit equal to 5 (normal muscle).

The anatomic diagram of the upper limb (area 4, fig. 1) is displayed (step 5, VIS): if the physician should wish to examine the peripheral nervous systems that innervates the lower limb (area 6, Fig. 1), he pushes (step 6, AI) a function key (for instance the key <) to display (step 7, SV) the relevant anatomic diagram.

Upon selection of the anatomic diagram of the limb to be examined, the initial of the first scanned muscle highlights (step 8, ESM) in the list of the test muscles of said limb (area 3 or 5, Fig. 1) and flashes (step 9, LSM) in all the cases of the anatomic diagram that contain it; if the muscle is judged to be "normal", one goes on (step 10, CM) to the following muscle (or to the preceding one),

pushing the key < or the key >: the initials of the just examined muscle switch off, those concerning the new muscle to be examined flash up (step 11, NM), while the initials of possible muscles already found to be deficient remain permanently switched on (step 12, SA) and the system goes back to step 10.

If the physician should consider as "deficient" the muscle under examination, he pushes the key L (step 10, CM) causing the "current" evaluation of the motion deficit (i.e. the last evaluation stored during the examination in progress or during the preceding examination) to flash (area 7, Fig. 1; step 13, VL): if such evaluation is correct for the tested muscle, the physician confirms it by pushing the key ENT (step 14, CV), the system associates it (step 15, VC) to the muscle under examination and switches on permanently the relevant initial in the anatomic diagram before going back to step 10; if the "current" evaluation is wrong, the physician modifies it by pushing the key < or the key > (any new pushing of either key causes the new evaluation to flash; step 16, VM) until the exact value is reached, which is confirmed by means of the key ENT (step 14, CB).

If the physician has initialized the ruler, the "current" evaluation of the motion deficit keeps to the initial value (no deficit) as long as normal muscles are examined, whose scanning is therefore particularly rapid.

The physician selects (step 10, CM) another muscle and the above

process is repeated until (at the end of the examination or whenever he deems it suitable) he pushes the key D to activate the function of evaluation of the lesion level.

As a response to the pushing of the key D, the nervous trunks that may be the sites of lesions are displayed (step 17, VT), which correspond to cases that contain the initials of alterated test muscles (evaluation < 5), taking into account the possible multiple lesions, as per the preceding Tables I and II; if this diagnosis level is deemed sufficient (step 18, FE), the examination ends, otherwise the physician (step 19, CE)

- pushes again the key D to go back to step 10 and to proceed with the examination; or
- pushes the key < to cause the highlighting of the nervous trunks corresponding to muscles with increasingly severe motion deficits (by pushing the key > one goes back to milder deficit levels): to each pushing of either key, the new selected value for the evaluation highlights (area 7, Fig. 1; step 20, NV), and for such value the nervous trunks that are probable lesion sites are displayed (step 21, VTN), which correspond to cases containing the initials of the alterated test muscles (characterized by an evaluation that does not exceed the selected one), taking into account the possible multiple lesions as per the preceding Tables I and II; if this diagnosis level is deemed sufficient (step 18, FE), the examination ends, otherwise the physician (step 19, CE) pushes

again the key T to go back to step 10 and to proceed with the examination, or he pushes again either key < or key > to change the selected evaluation level.

Fig. 4 and 5 (taken from the instruction handbook attached to the ruler) show respectively the set of explanatory pictures which shows the physician how the individual test muscle of the upper limb and the lower limb respectively should be examined to make a correct evaluation of the possible motion deficit: under each explanatory picture the muscle tested each time is indicated by the corresponding initial listed on Fig. 1, taken, in its turn, from the instruction handbook.

According to a particular embodiment of this invention, the ruler above described with reference to the attached drawings, may be equipped with a display having advanced graphic capabilities (for instance, a liquid crystal colour display or any other equivalent display means), suitable to display (on request by the physician) anatomic diagrams, test muscles lists, explanatory pictures as the ones illustrated as mere examples on Fig. 4 and 5, pictures (as those of Fig. 5 and 6) utilized for the so-called "sensitive analysis" (which will be disclosed later on) and other possible information which can be displayed in graphic form: this makes unnecessary the printed information handbook which can be omitted.

Preferably but non necessarily, in the first test muscle list at least part of the test muscles of the upper limb (and the

corresponding identification initials) are grouped according the three main nervous trunks (median, ulnar and radial nerve), by which the above test muscles are innervated; in the same way, in the second test muscle list at least part of the test muscles of the lower limb (and the corresponding identification initials) are grouped according to the two main nervous trunks (internal and external popliteal hischiatic nerve) by which the above test muscles are innervated.

By utilizing such ruler having advanced graphic capabilities, the diagnosis procedures are not different from the ones above described with reference to Fig. 2 and 3; however, in making the diagnosis, the physician is helped by the fact that, by displaying the anatomic diagram of the limb to be examined (either individually or associated to the relevant test muscle list), he can refer (if and when he should deem it necessary and/or helpful) to the relevant explanatory pictures (Fig. 4 and 5) recalled on the display from the ruler memory and go back after the reference to the anatomic diagram of the tested limb.

Besides, when a test muscle has been recalled and its condition (normal or alterated) and the severity of the possible motion deficit have been evaluated, the condition and possible motion deficit of such test muscle may be either highlighted by means of a panel analogous to the third area 7 of the ruler of Fig. 1, or (preferably) visually indicated by means of the colour of the

initial of said test muscle in all of the cases of the anatomic diagram in which such muscle appears: this allows the physician to evaluate at first sight the whole picture, to timely notice any possible inconsistency (by repeating, if necessary, the evaluations, if any, that do not appear to be consistent with the whole picture) and/or to make a first provisional diagnosis, to be confirmed by activating the function "EVALUATION OF THE LESION LEVEL" as described above.

The ruler having advanced graphic capabilities also permits to perform at any moment, either during the above described diagnosis procedures or independently from them, the so-called "sensitive analysis" (more exactly: "analysis of the topography of the sensory disorder"). The physician recalls from the ruler memory and displays a set of pictures (as those illustrated as mere examples on Fig. 5 and 6) each of which schematically shows the cutaneous region innervated by the nerve indicated under the same picture, and compares such regions with those concerned by the possible sensory disorder complained by the patient to localize the presumably impaired nerve.

Sensitive analysis permits to preliminarily orientate the diagnosis procedures based on motion deficits and/or to confirm the diagnosis obtained by means of said procedures, but it is particularly advantageous whenever no motion deficits are found, as in such case it allows the physician to detect a damage which cannot be localized

by means of the above described diagnosis procedures limited to the sensitive nervous fibres only.

In this description of a ruler having advanced graphic capabilities, all the computer-aided graphic programmes (well known to all the technicians of this sector) are omitted which allow to display on the ruler's display anatomic diagrams, test muscle lists and all other pictures (as the ones given as an example from Fig. 4 to 7) which allow the physician to carry out the sensitive analysis and/or which orientate him for a correct use of the ruler, integrating or preferably substituting for the instruction handbook.

Without trespassing the field of this invention, it is possible to interface (in an already known way) the electronic apparatus object of this description (and in particular the ruler having advanced graphic capabilities) with a computer (either a personal computer or any other technically equivalent means) or to associate said apparatus to a computer suitable to make the diagnosis of possible nervous lesions by means of procedures that are practically identical (the possible differences being limited to irrelevant aspects, such as, for instance, a different choice and/or utilization of function keys) to those illustrated for the ruler with reference to Fig. 2 and 3 and to the possible "sensitive analysis" (Fig. 5 and 6).

In both the above circuital embodiments, the use of a computer allows to store, process, compare among one another (also to

research and/or statistical purposes) and anyway to manage at will the data however acquired by means of the above diagnosis procedures and to integrate such diagnostic data (pre-processed, if necessary) with further data (first name, name, age, anamnesis, etc.) concerning the patient, in order to set up and/or update a computer clinical record of the patient, realized by means of one of the programmes for the management of medical consulting rooms that are available on the market; such management programmes and the computer graphic programmes for displaying the pictures on the monitor are not described herein, being well known to any technician of the sector.

Without trespassing the field of this invention, a technician can change the structure and/or the working of the electronic apparatus subject of this invention to adapt it to the individual needs, as well as introduce any further change or improvement suggested by the normal experience and the natural evolution of the art.

CLAIMS

1. An electronic apparatus for localizing the site of lesions of the peripheral nervous system, characterized in that it comprises means (9) suitable for displaying at least

- a first and a second anatomic diagram (4, 6) representing said peripheral nervous system which constitutes the brachial and the lumbosacral plexus respectively;

- a set of cases located at the branching points and in correspondence of the twigs of said first and second anatomic diagram (4, 6), a set of muscles (test muscles) innervated by the corresponding section of said peripheral nervous system being indicated in each of said cases, a motion deficit of said test muscles being associated to a lesion of said section of said peripheral nervous system;

- means suitable to highlight, as a response to the distribution of said test muscles marked by means of function keys, the case localizing the site of said lesion;

and in that it comprises also a set of function keys allowing at least to scan said test muscles and to mark those showing a motion deficit.

2. An electronic apparatus according to claim 1, characterized in that said case highlighted by said display means comprises all and only said marked test muscles.

3. An electronic apparatus according to claim 1, characterized in

that said case highlighted by said display means comprises all said marked test muscles and other unmarked test muscles, the possible motion deficit of said further test muscles being not significant for the specific type of lesion.

4. An electronic apparatus according to claim 1, characterized in that said function keys are apt to associate to each of said marked test muscles an evaluation of the severity of the corresponding motion deficit.

5. An electronic apparatus according to claims 2 and 4, characterized in that said case highlighted by said display means comprises all and only said marked test muscles showing a motion deficit whose severity is not lower than a preset value.

6. An electronic apparatus according to claims 3 and 4, characterized in that said case highlighted by said display means comprises all said marked test muscles showing a motion deficit whose severity is not lower than a preset value, and further unmarked test muscles, the possible motion deficit of said further unmarked test muscles being not significant for the specific type of lesion.

7. An electronic apparatus according to claim 1, characterized in that it comprises two valves (1, 2) folding like a book; in that on the internal surface of said first valve (1) an instruction handbook is placed, comprising at least a list of said test muscles of the upper limb and the lower limb respectively, innervated by said

peripheral nervous system which constitutes said brachial plexus and said lumbosacral plexus respectively, each test muscle being associated to an identification initial; in that said second valve (2) comprises said means (9) suitable for displaying, in order

- a first area (3) comprising said identification initials of said test muscles of said upper limb;
- said first anatomic diagram (4) representing, with the indication of the motor roots and nervous trunks which form in succession up to the twigs, said peripheral nervous system which constitutes said brachial plexus, said first anatomic diagram (4) comprising, at each branching point and in correspondence of each of said twigs, a case containing said identification initials of said test muscles of said upper limb, whose motion deficit may be associated to a lesion localized in said branching point or in correspondence of said twig respectively;
- a second area (5) comprising said identification initials of said test muscles of said lower limb;
- said second anatomic diagram (6) representing, with the indication of the motor roots and nervous trunks which form in succession up to the twigs, said peripheral nervous system which constitutes the lumbosacral plexus, said second anatomic diagram (6) comprising, at each branching point and in correspondence of each of said twigs, a case containing said identification initials of said test muscles of said lower limb whose motion deficit may be associated to a lesion

localized in said branching point or in correspondence of said twigs respectively;

- a third area (7) comprising means suitable for displaying an evaluation of the possible motion deficit of one of said test muscles;

- said means suitable for highlighting, as a response to the distribution of said test muscles marked by means of function keys, said case individuating said site of said lesion;

and in that said second valve (2) also comprises said set of function keys (8) allowing to scan said test muscles and to mark those that show a motion deficit.

8. An electronic apparatus according to claim 7, characterized in that said case highlighted by said display means comprises all and only said marked test muscles.

9. An electronic apparatus according to claim 7, characterized in that said case highlighted by said display means comprises all said marked test muscles and further unmarked test muscles, the possibible motion deficit of said further test muscles being not significant for the specific type of lesion.

10. An electronic apparatus according to claim 7, characterized in that at least part of said test muscles of said upper limb and the corresponding identification initials contained in said first area (3) are grouped according to the three main nervous trunks (median, ulnar and radial nerve) by which said test muscles are innervated.

11. An electronic apparatus according to claim 7, characterized in that at least part of said test muscles of said lower limb and the corresponding identification initials contained in said second area (5) are grouped according to the two main nervous trunks (internal and external hischiatic popliteus nerve) by which said test muscles are innervated.

12. An electronic apparatus according to claim 7, characterized in that said set of function keys (8) is also suitable for associating to each of said marked test muscles an evaluation of the corresponding motion deficit.

13. An electronic apparatus according to claims 8 and 12, characterized in that said case highlighted by said display means comprises all and only said marked test muscles showing a motion deficit whose severity is not lower than a preset value.

14. An electronic apparatus according to claims 9 and 12, characterized in that said case highlighted by said display means comprises all said test muscles showing a motion deficit whose severity is not lower than a preset value, and further unmarked test muscles, the possible motion deficit of said further test muscles being not significant for the specific type of lesion.

15. An electronic apparatus according to claim 7, characterized in that said display means (9) are suitable to display said first, second and third area (3, 7, 7), said first and second anatomic diagram (4, 6) and said highlighting means of said site of said

lesion.

16. An electronic apparatus according to claim 7, characterized in that said first valve (1) constitutes the lid of said ruler.

17. An electronic apparatus according to claim 1, characterized in that said means (9) are suitable for displaying at least:

- a first list of said test muscles of said upper limb, innervated by said peripheral nervous system which constitutes the brachial plexus, each test muscle being associated to an identification initial;

- said first anatomic diagram (4) representing, with the indication of the motor roots and the nerve trunks that form in succession up to the twigs, said peripheral nervous system which constitutes the brachial plexus, said first anatomic diagram (4) comprising at each branching point and in corresponcence of each of said twigs a case containing said identification initials of said test muscles of said upper limb whose motion deficit may be associated to a lesion localized in said branching point or in correspondence of said twig respectively;

- a second list of said test muscles of said lower limb, innervated by said peripheral nervous system, which constitutes said lumbosacral plexus, each test muscle being associated to an identification initial;

- said second anatomic diagram (6) representing, with the indication of the motor roots and the nervous trunks which form in succession

up to the twigs, said peripheral nervous system which constitutes said lumbosacral plexus, said second anatomic diagram (6) comprising at each branching point and in correspondence of each of said twigs a case containing said identification initials of said muscles of said lower limb whose motion deficit may be associated to a lesion localized in said branching point or in correspondence of said twigs respectively;

- said means suitable to highlight, as a response to the distribution of said test muscles marked by means of said function keys, said case localizing said site of said lesion;

and in that said set of function keys (8) allow to lead said means (9) to scan said test muscles and to mark those that show a motion deficit.

18. An electronic apparatus according to claim 17, characterized in that said display means (9) are of the liquid crystal type.

19. An electronic apparatus according to claim 17, characterized in that, as a response to said set of function keys (8), said display means (9) separately show said first list of test muscles, said first anatomic diagram, said second list of test muscles and said second anatomic diagram.

20. An electronic apparatus according to claim 17, characterized in that, as a response to said set of function keys (8), said display means (9) show at the same time said first test muscles list and said first anatomic diagram or said second test muscle list and said

second anatomic diagram respectively.

21. An electronic apparatus according to claim 17, characterized in that said case highlighted by said display means comprises all and only said marked test muscles.

22. An electronic apparatus according to claim 17, characterized in that said case highlighted by said display means comprises all said marked test muscles and further unmarked test muscles, the possible motion deficit of said further test muscles being not significant for the specific type of lesion.

23. An electronic apparatus according to claim 17, characterized in that at least part of said test muscles of said upper limb and the corresponding identification initials shown in said first list are grouped according to the three main nervous trunk (median, ulnar and radial nerve) by which said test muscles are innervated.

24. An electronic apparatus according to claim 17, characterized in that at least part of said test muscles of said lower limb and the corresponding identification initials shown in said second list are grouped according to the two main nervous trunks (internal and external hischiatic popliteus nerve) by which said test muscles are innervated.

25. An electronic apparatus according to claim 17, characterized in that said function keys (8) are also suitable for associating to each of said marked test muscles an evaluation of the corresponding motion deficit.

26. An electronic apparatus according to claims 17 and 25, characterized in that said display means (9) are suitable for highlighting the severity of the possible motion deficit associated to each of said test muscles by means of said function keys (8).

27. An electronic apparatus according to claim 26, characterized in that said severity of said possible motion deficit is highlighted by assigning a corresponding colour to said initial of said test muscle in all said cases containing said initial that refer to said first or said second anatomic diagram respectively.

28. An electronic apparatus according to claims 21 and 25, characterized in that said case highlighted by said display means comprises all and only said marked test muscles that show a motion deficit whose severity is not lower than a preset value.

29. An electronic apparatus according to claims 22 and 25, characterized in that said case highlighted by said display means comprises all said marked test muscles that show a motion deficit whose severity is not lower than a preset value, and further unmarked test muscles, the possible motion deficit of said further test muscles being not significant for the special type of lesion.

30. An electronic apparatus according to claim 17, characterized in that said display means (9) are suitable for highlighting also a set of explanatory pictures suitable to illustrate how each of said test muscles of said lower limb or said upper limb respectively should be examined, to make a correct evaluation of said possible

motion deficit.

31. An electronic apparatus according to claims 17 and 30, characterized in that, as a response to said function keys (8), said display means (9) present said explanatory pictures as an alternative to said first and to said second anatomic diagram respectively (4, 6).

32. An electronic apparatus according to claim 17, characterized in that said display means (9) are suitable for highlighting also a set of further pictures, showing each the skin region innervated by said nerves, and in that a possible sensory disorder in one of said regions suggests the impairment of the corresponding nerve.

33. An electronic apparatus according to claims 17 and 32, characterized in that, as a response to said function keys (8), said display means (9) show said further pictures as an alternative to said first and said second anatomic diagram respectively (4, 6).

34. An electronic apparatus according to claims 17 and 32, characterized in that, as a response to said function keys (8), said display means (9) show said further pictures independently from said first and said second anatomic diagram respectively (4, 6).

TEST MUSCLES, UPPER LIMB

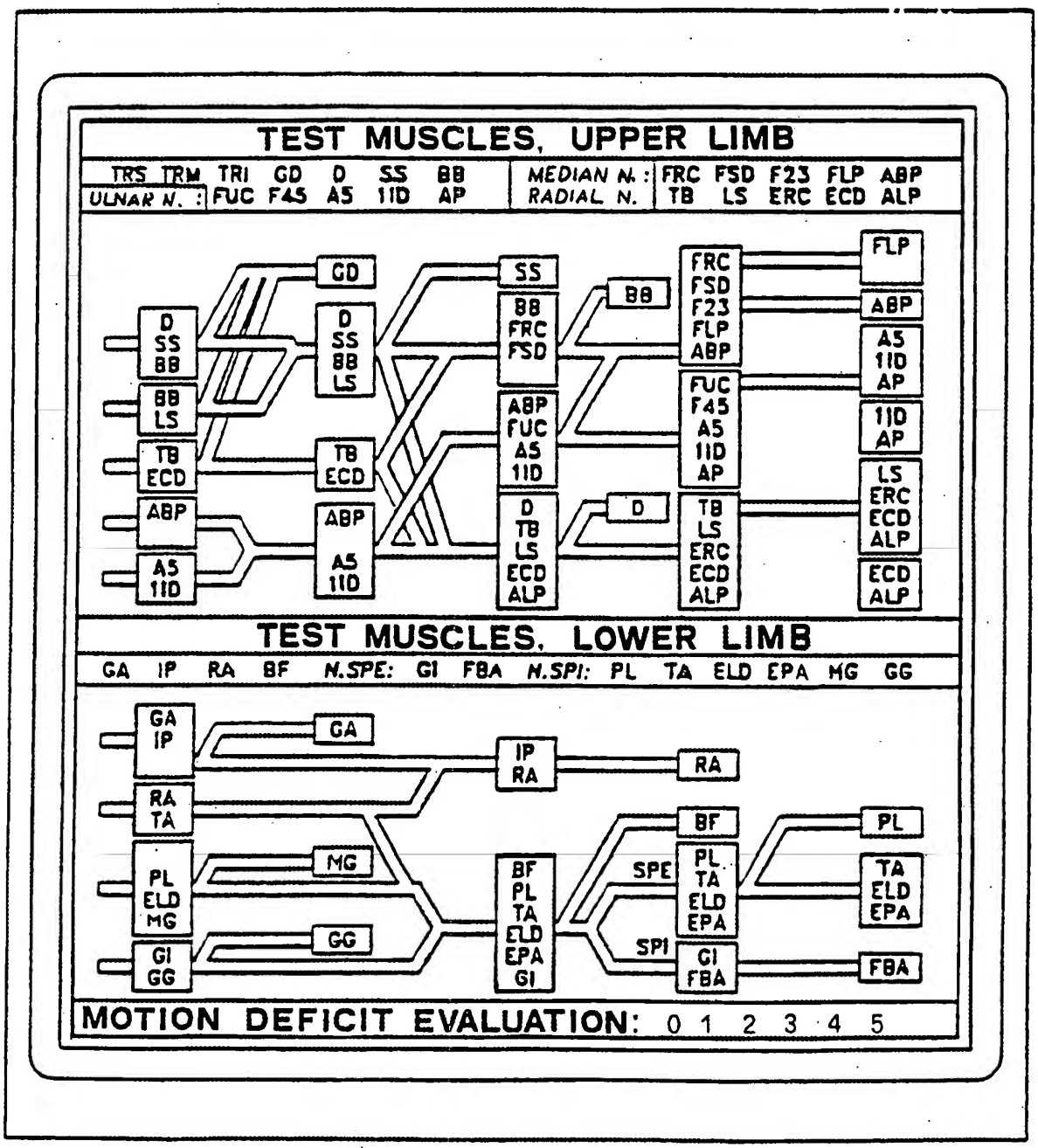
Serratus Magnus	GD	Ulnar N.	
Deltoid (C5)	D	Flexor Carpi Ulnaris	FUC
Infraspinatus (C5)	SS	Flexor Digitorum	F45
Biceps Br. (C6)	BB	Profundus 4-5	
		Abductor Digiti	A5
Median N.		minimi (T1)	
Flexor Carpi Rad.	FRC	First Dorsal	1ID
Flexor Digitorum Sup.	FSD	Interosseus (T1)	
Flexor Digitorum	F23	Abductor Pollicis	AP
Profundus			
Flexor Pollicis	FLP	Radialis N.	
Longus			
Abductor Pollicis	ABP	Triceps Br. (C7)	TB
Brevis (C2)		Brachioradialis (C6)	LS
		Extensor Carpi Rad.	ERC
		Extensor Digitorum	ECO
		(C7)	
		Abductor Pollicis	ALP
		Longus	

TEST MUSCLES, LOWER LIMB

Abductor Longus (L3)	GA	Common Peroneal N.	
Iliopsoas (L3)	IP	Peroneus longus (L5)	PL
Rectus Femoris (L4)	RA	Tibialis Anterior (L4)	TA
Biceps Femoris	BF	Extensor Digitorum	ELD
		Longus (L5)	
Common Peroneal N.		Extensor Hallucis	EPA
Medial Gastoonemius (S1)	GI	Longus	
Flexor Hallucis Brevis	FBA	Gluteus medius (L5)	MG
		Gluteus maximus (S1)	GG

FIG.1A

SUBSTITUTE SHEET



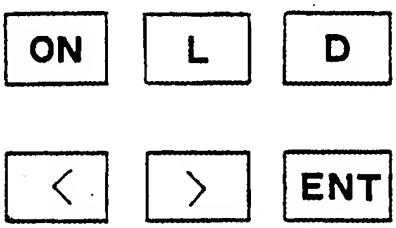


FIG.1B

SUBSTITUTE SHEET

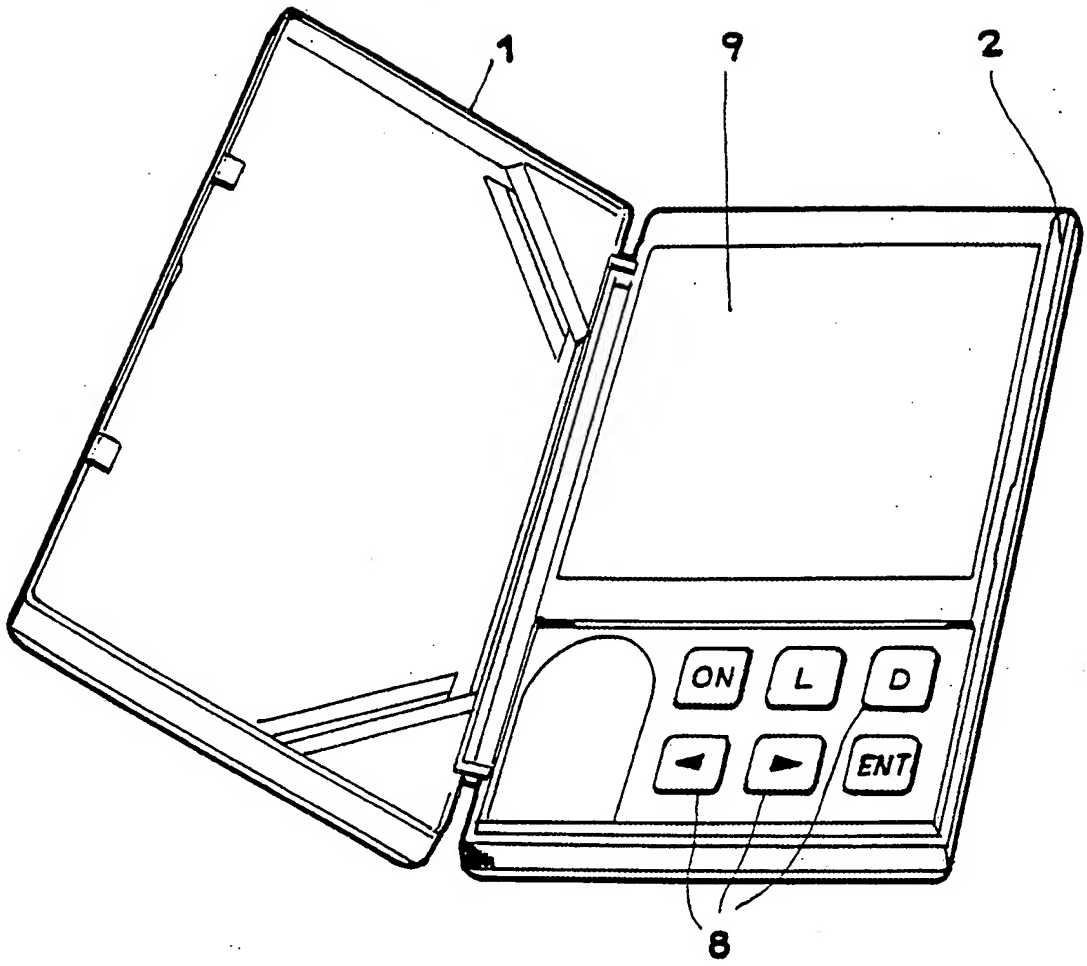
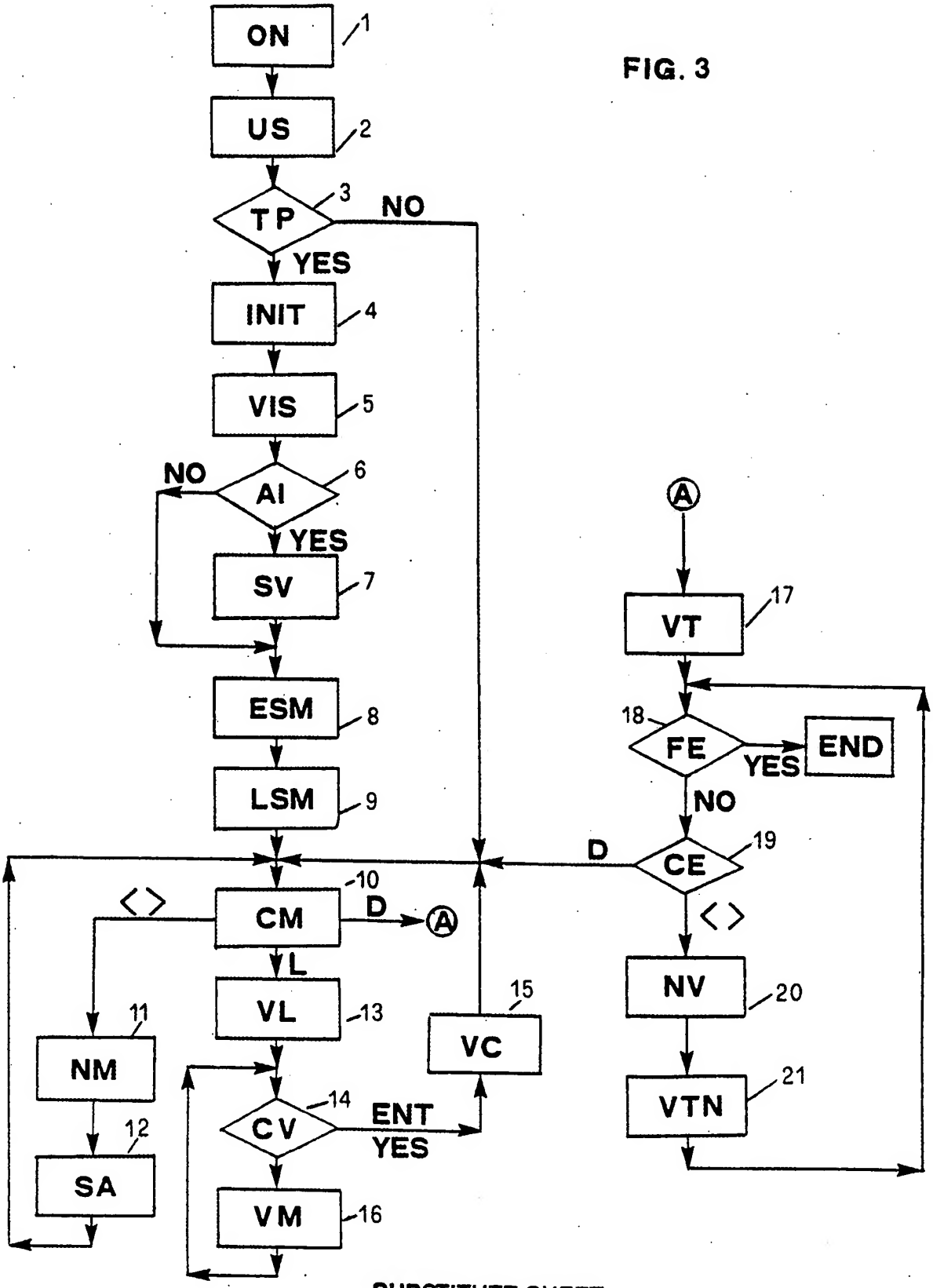


FIG. 2

FIG. 3



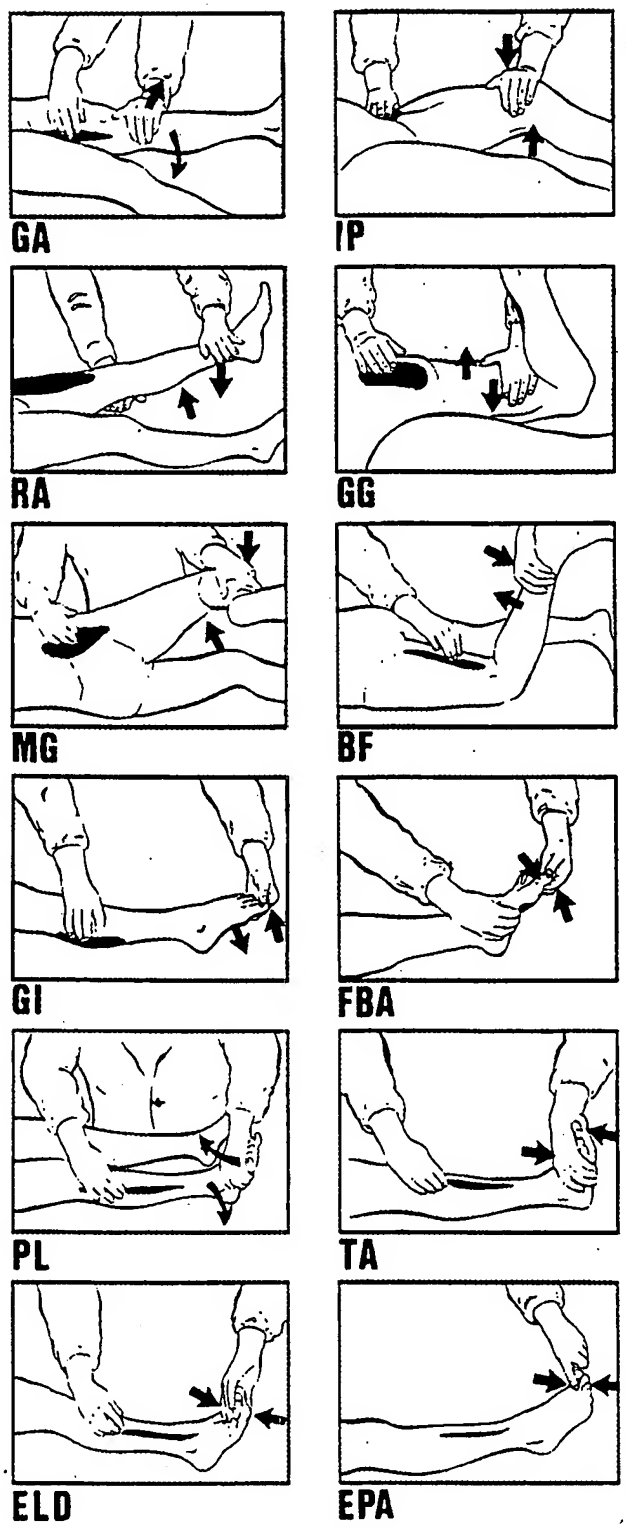


FIG.4

SUBSTITUTE SHEET

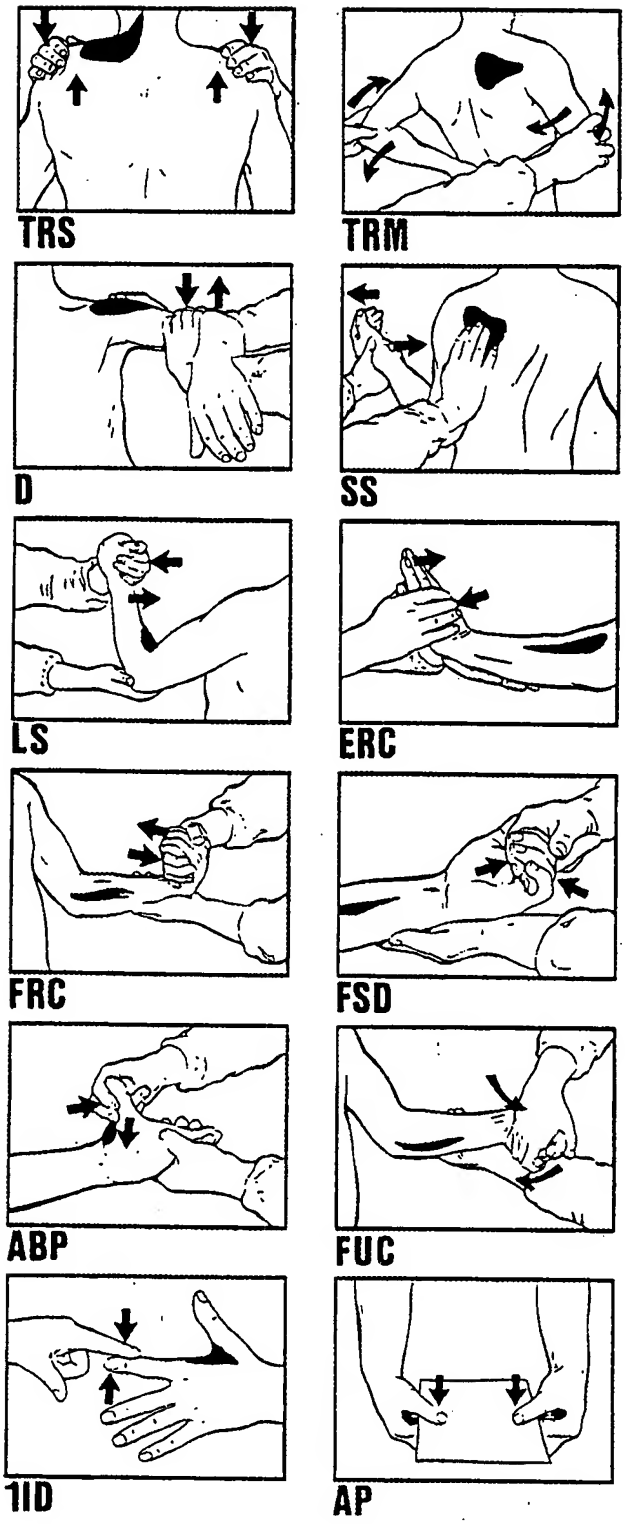


FIG.5A

SUBSTITUTE SHEET

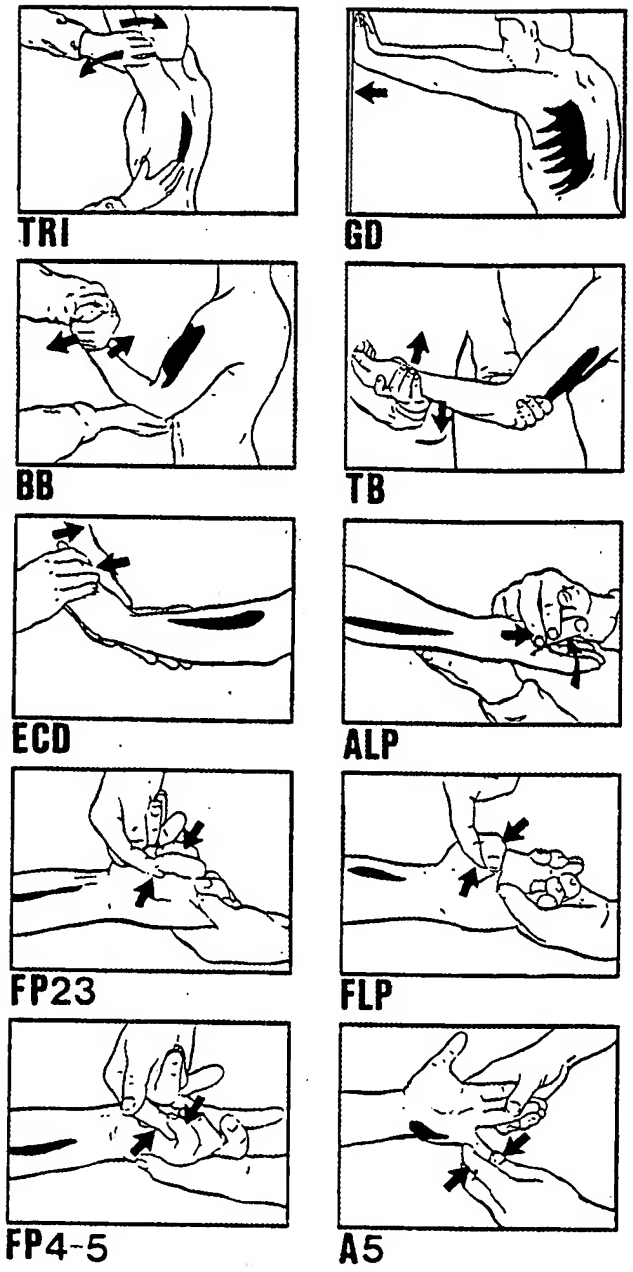


FIG. 5B

SUBSTITUTE SHEET

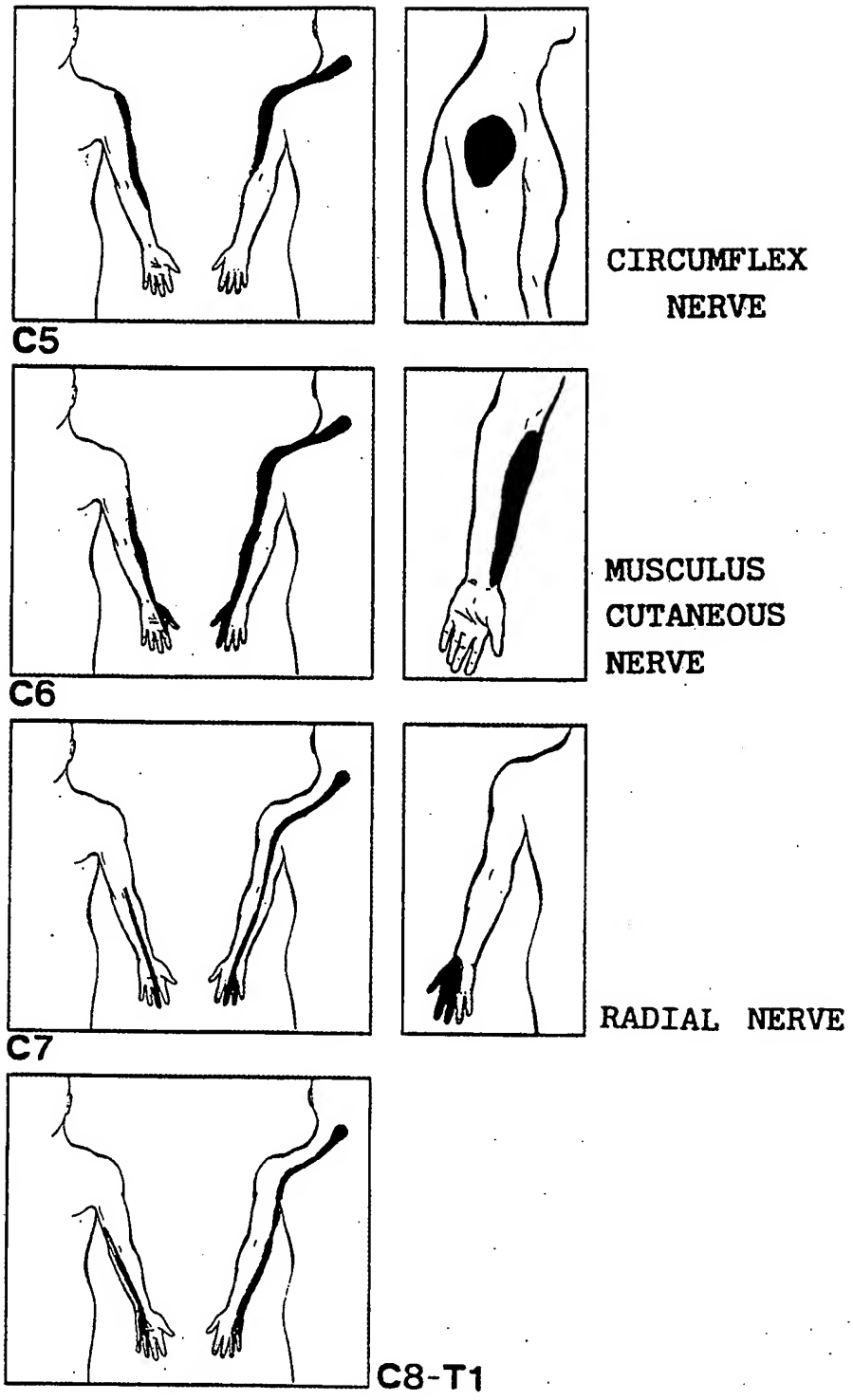
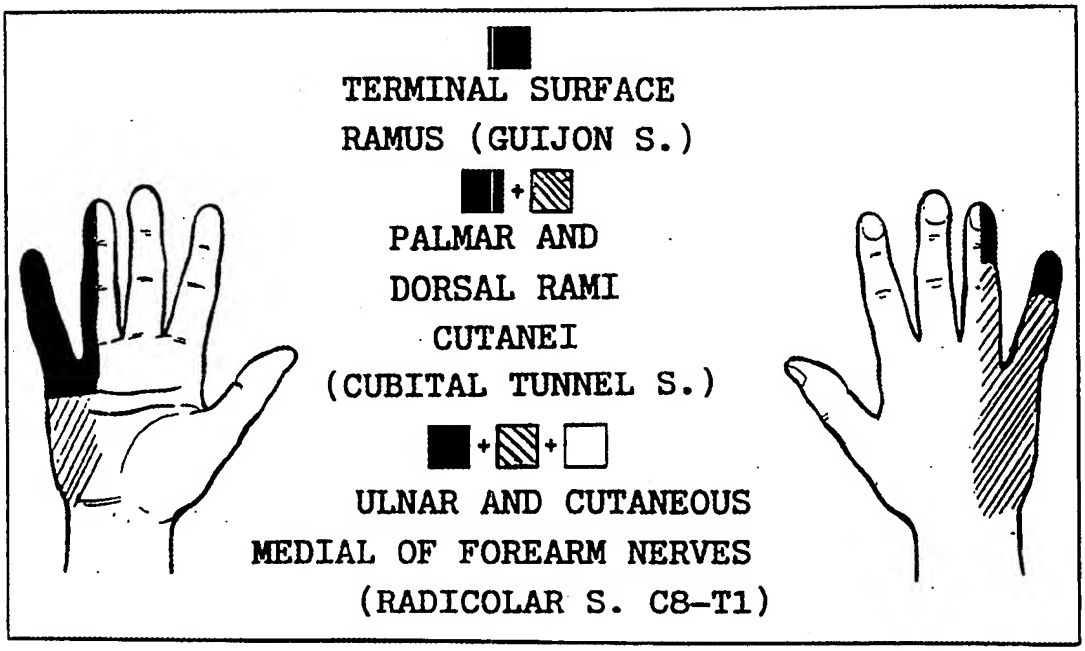
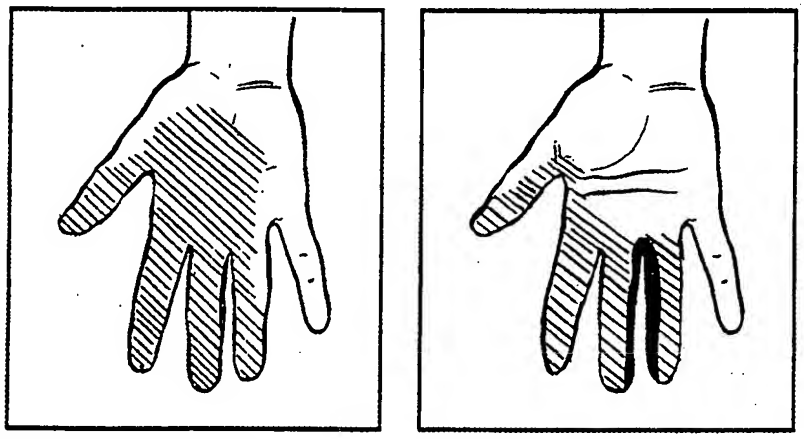


FIG. 6A

SUBSTITUTE SHEET



SENSORY DISEASE OF ULNAR REGION



MEDIAN NERVE

CARPAL TUNNEL
SYNDROME

FIG.6B

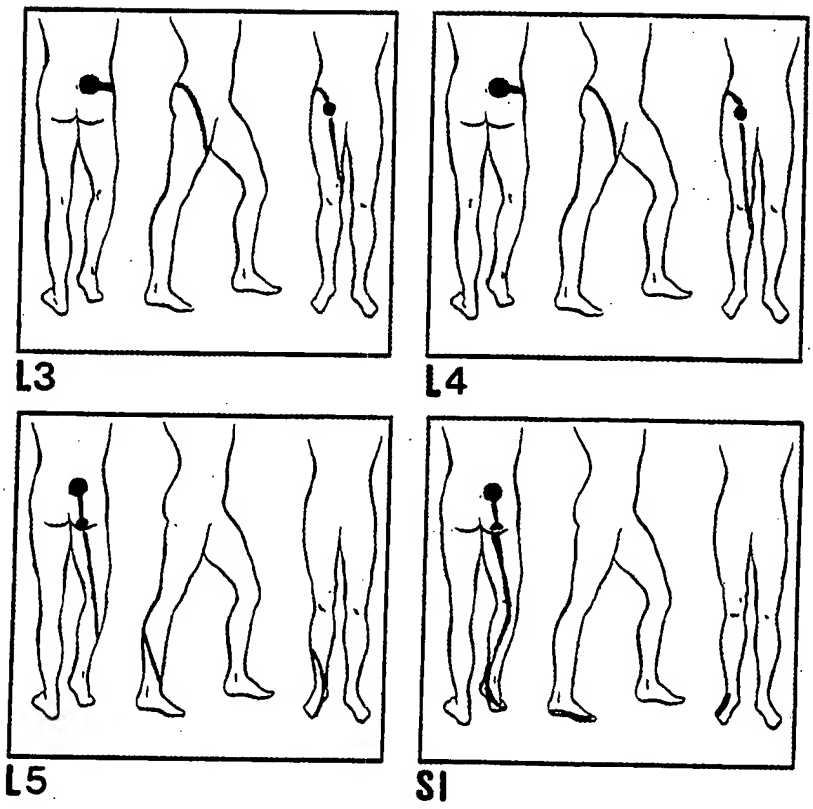
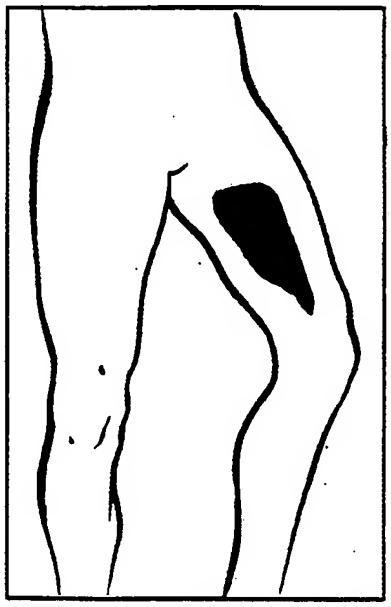


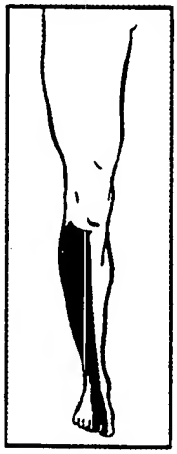
FIG.6C

FEMOROCUTANEOUS NERVE

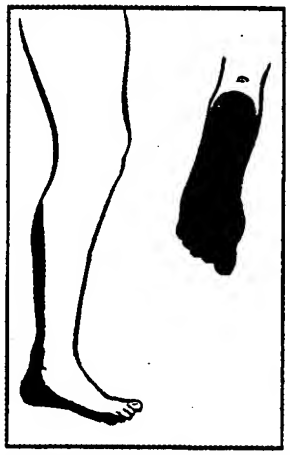


OBTURATOR NERVE

FEMORAL NERVE



PERONEAL NERVE



TIBIALIS NERVE

FIG. 7

SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 93/00539

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 A61B5/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	A61B ; G09B ; G06F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category[10]	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	WO,A,9 108 702 (FARDIN) 27 June 1991 see page 2, line 10 - page 10, line 4 see figures	1
Y	EP,A,0 303 930 (SYNTHES AG) 22 February 1989 see page 4, line 4 - page 6, line 55 see figures 1-17	1
A		7,15,17, 31
A	EP,A,0 470 837 (ALLEN) 12 February 1992 see page 4, line 9 - page 5, line 21 see page 10, line 1 - page 13, line 13 see figures	1,7,17, 18

-/--

[10] Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
24 JUNE 1993	05 JUIL. 1993
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	CHEN A.H.

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	GB,A,2 218 546 (REID) 15 November 1989 see page 5, line 15 - page 19, line 7 see figures	1

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

EP 9300539
SA 71830

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 24/06/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9108702	27-06-91	EP-A- 0458928	04-12-91
EP-A-0303930	22-02-89	US-A- 4839822	13-06-89
EP-A-0470837	12-02-92	CA-A- 2048122	11-02-92
		JP-A- 4273380	29-09-92
GB-A-2218546	15-11-89	None	

EPO FORM P0479

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82